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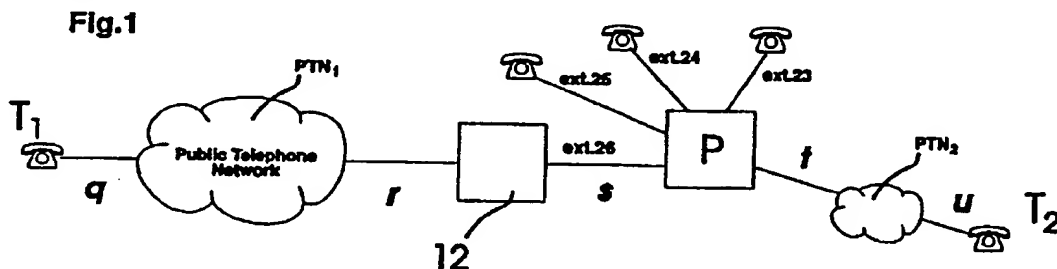
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## (54) Telecommunication systems

(57) Most modern private telephone systems - known as, and referred to hereinafter as, Private Automatic Branch Exchanges (or PABXs) - provide many more facilities than do the normal public telephone systems. Unfortunately, while some of the latest public Exchanges have a limited number of these facilities, they are nevertheless severely restricted by comparison with PABXs.

It would be very convenient to have the full facilities of a PABX (P) available to any telephone (T<sub>1</sub>) connectable remotely thereto by the public system (PTN<sub>1</sub>), and the invention seeks to permit this by suggesting the use, operationally interposed between the private system (P) and the public system (PTN<sub>1</sub>), of an interface (12) that allows the remote phone (T<sub>1</sub>) to send control signals through the public system (PTN<sub>1</sub>) to the private system (P) so as to cause the latter to operate in the manner required.



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Fig.1

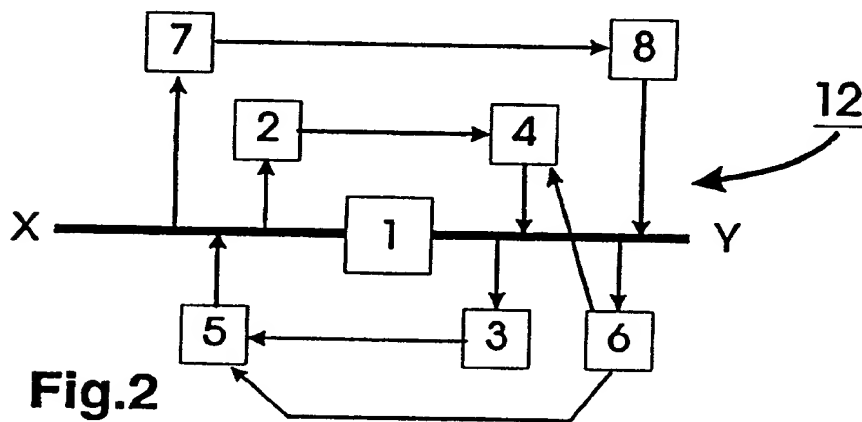
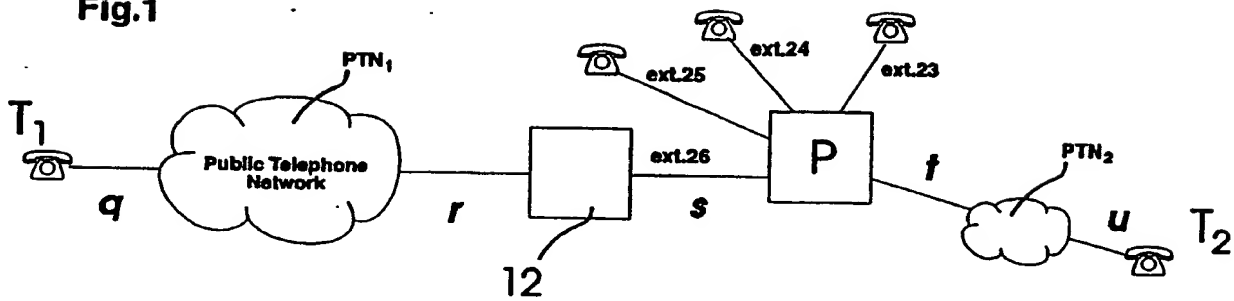
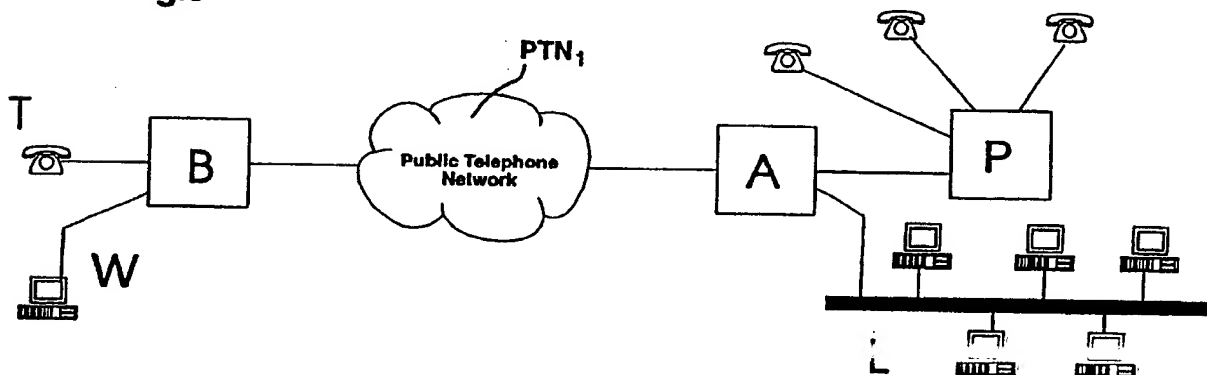


Fig.3



Telecommunication systems

This invention relates to telecommunication systems, and concerns in particular such systems involving a facility-providing private telephone system. More specifically, the invention relates to a remote access telecommunication system intended to enable a telephone, and optionally a device such as a computer, which is remote from a private system to be connectable thereto via a public telephone system in such a way that there are then available between the remote telephone (and/or other device) many, if not all, of the facilities that would normally be available if it were directly connected to that private telephone system.

Most modern private telephone systems - known as, and referred to hereinafter as, Private Automatic Branch Exchanges (or PABXs) - provide many more facilities than do the normal public telephone systems. For example, they provide the capability to transfer a call to another telephone after it has been answered, to put a call temporarily on hold while making an enquiry call to another telephone, and to set up three- or more-way conversations. They may also permit digital signals, such as are output by most modern computers, to be transmitted around the relevant network without the need for a MoDem (a device that converts the digital signal into a modulated tone for onwards transmission, and that subsequently demodulates a received tone to form a digital signal). Unfortunately, while some of the latest public Exchanges have a limited number of these facilities, they are nevertheless severely restricted by

comparison with PABXs. Accordingly, where one of the two telephones linked by a PABX is connected remotely thereto by a public telephone system the two do not enjoy equally the full facilities provided by the PABX; more specifically, the remote 'phone is unable to make significant use of the capabilities of the private system. The reason for this is quite simply that the method already standard for controlling most private systems, which is for the activating 'phone to use the Recall button/signal to alert the system to the fact that it is about to receive a command to take some special action (such as putting the call on hold), does not work when the activating 'phone is such a remote 'phone, for the signal output by the Recall button is not usually of the right sort to be propagated through the public Exchange system to the private system.

It would be very convenient to have the full facilities of a PABX available to any telephone connectable remotely thereto by the public system, and the invention seeks to permit this by suggesting the use, operationally interposed between the private system and the public system, of what one might call a magic box that allows the remote 'phone to send control signals through the public system to the private system so as to cause the private system to operate in the manner required.

In one aspect, therefore, this invention provides a remote access telecommunications system wherein a facility-providing private telephone system is connectable into some public telephone system whereby it may be linked to a remote 'phone, in which remote access system there is, operationally interposed between the private system and the public system, control means that

allows the remote 'phone to send control signals through the public system to the private system so as to cause the private system to operate in the facility-providing manner required.

In theory the telephones to be connected according to the invention may be of any sort, but from a practical point of view the modern "tone" 'phone is more easily integrated into this type of system than the older "pulse" 'phone. Furthermore, where the public system is already a digital system it may be advantageous to use a digital telephone (that is, one that within itself converts the input analogue sound into a digital signal before sending it on down the line to the telephone Exchange, and *vice versa*).

Moreover, although throughout this Specification there is used the term "telephone" (or "'phone") to identify the apparatus at either end of the connection, it has already been intimated that devices such as computers may be connected using a remote communications system according to the invention, and thus it will be understood, as is discussed in more detail hereinafter, that the "telephone" may actually be some other sort of data sending and receiving device, and that it may specifically be a computer (or some comparable device).

The connection of either the remote 'phone or the control means into the public system can be effected in any convenient way - thus, for example, by a copper wire cable, by a co-axial cable, by a fibre optic system, or by a microwave or cellular radio system. To enable the full range of facilities the 'phone or control means connection is most desirably a digital one - digital connections able to transfer data at at least 64 kilobits per second are becoming the standard - but

it is nevertheless possible to get some benefit even when the connection is a conventional analogue one along a copper wire pair.

As noted hereinbefore, modern digital telephone systems (including public systems) provide the capability to send digital data at high speed between two points without first converting the data into an analogue form. Such a public system is commonly called an Integrated Services Digital Network (ISDN). Although digital transmission has largely been utilised to allow computers to communicate, its use is increasing for conventional voice telephony. Moreover, data compression technology now permits successful voice communication across fully-digital networks without using the entire information-carrying capacity of the link, so that it is therefore possible simultaneously to employ the link for both voice telephony and computer data communication between the same locations. While the full benefits of the invention may only be attainable where the relevant public system is a digital one, nevertheless advantages can accrue even when the system uses very old-fashioned electromechanical Exchanges of the Strowger type.

The invention involves the use of control means that enable a remote telephone, that can be linked via a public 'phone system to a private Exchange system with lots of desirable facilities, to make use of the private system's facilities - so that obviously the facilities that will actually be available to the remote 'phone will depend upon what the private system has to offer. Typically, though, the remote 'phone will, in accordance with the invention, be able to take advantage of call forwarding, call transfer, call diversion, and

conference calls just as though it were directly connected to the private system.

In order to permit the remote 'phone to have the required facilities, there must, according to the invention, be control means operationally interposed between the private system and the public system, these control means allowing the remote 'phone to send control signals through the public system to the private system so as to cause the private system to operate in the manner required. This control means may take one or other of many different forms, but each will obviously be able to connect - both mechanically/electrically and as regards signal recognition - into the public system in an appropriate way (once suitably physically plugged in it may automatically configure itself to fit the public system, or it may have to be adapted thereto by hand), and each will be able to recognise when it has received a control signal instructing it to take some action other than merely allowing through whatever information signal is being transferred from 'phone to 'phone (such an action being to alert the receiving private system to the fact that it is about to be sent a control signal of its own).

Clearly, the nature of the control means' physical connection to the public system (and, of course, to the private system on its other side) can be any appropriate to the systems themselves, and needs no further comment at this time. Equally clearly, the "signal interface" necessary to allow the control means to communicate with either system can also be whatever is appropriate, and this, too, needs no further comment at this time. Even so, a typical physical connection to either system might be an ISDN-2 Basic Rate connection, or (less desirably) a conventional analogue direct exchange pair. For

digital data, as might be output by a remote computer, the connections are preferably of the standard RS232 variety (where both a telephone and a computer are connectable at either end of the link, the interface electronics may be implemented on a card that slots directly into the computer), and the connection to the (or each) computer may be along any sort of computer network link (for many small Local Area Networks this is likely to be an Ethernet system using thin coax cable).

It will be appreciated that there are many ways for the remote 'phone to send meaningful control signals to the control means, and then to have the control means able to recognise that it has indeed received from the remote 'phone a control signal informing it to to instruct the private system to take some special action. For example, the control signals from the remote 'phone may be transmitted as a (normally unlikely) sequence of audio tones (applicable for either analogue or digital signals), or as a particular and pre-defined data sequence (digital only). With a conventional tone 'phone it might be thought most convenient to employ the method already standard for controlling most private systems, which is to use the Recall button/signal, but as observed hereinbefore the signal output by the Recall button is unfortunately not usually of the right sort to be propagated on into the public Exchange system, and therefore what is required is to alert the control means by sending it some other, unusual, signal (as noted above), that *does* pass through the public system, and then to have the control means convert this into an actual Recall signal that it can pass on to the connected private system so as to alert the latter to ready itself to receive its own control signal. And to then instruct the private system what action to take it is preferable to feed it with the same control signals



that it would normally receive from a telephone connected directly to it. Thus, after sending the special signal to alert the private system that it is about to be sent a control signal, there is then keyed in, at the remote 'phone, a number - typically a one-digit number selected from a range of pre-selected such numbers - that defines what action it is to take.

The control means allows the remote 'phone to send control signals through the public system to the private system so as to cause the private system to operate in the manner required. It does this conveniently by recognising a special alerting signal, and then itself alerting the private system to interpret the appropriate ones of the subsequent signals as action commands, and to carry out whatever action they define. The nature of the control means, which naturally enables it to operate in the desired manner, may be of any sort, but in principle it will comprise means for sending onwards in an appropriate format User information (speech signals or computer data) incoming in either direction, as well as means for responding to and sending control information to each of the public and private systems, and means for translating control information received from either system into a suitable format for onwards transmission to other private systems. The control information to be received and detected will include ringing signals and audio or digital control commands. These will be responded to with off-hook and recall signals and audio or digital control commands (suitably translated if necessary). In addition, there may a "timeout" capability, forcibly to return both interfaces to their idle state after a predetermined period of inactivity.

At a more detailed level, the control means will comprise a data line connectable between the public and the private systems together with a remote 'phone control signal detect means examining the data line input signals and operatively connected to a private system control signal generator means outputting to the data line output. In addition it will very preferably include means for blocking any DC component of the data line signal (so protecting the systems' delicate electronics) but will have means enabling this to be bypassed by a ringing tone (sent from either end), and so conveniently has two ringing tone detection means linked one to each of the data line input and output and capable when activated of bypassing the DC block (and to ensure that the system is still protected there is preferably an associated "time-out" arrangement that will de-activate the bypass after some suitable time)

Establishment of calls from the remote 'phone to the private system via the remote access system of the invention is conveniently achieved simply by the remote User dialling the public network number of the line to which the invention's remote access system is connected. The Caller may then receive a dial tone directly from the private system, or alternatively may be required first to enter a secret code to continue into the private system (and in the latter case, if the code is unique to the Caller the private system may be configured to call back to the remote 'phone number, which will have been pre-programmed into the invention's system, to confirm that the Caller is entitled to make this use of the system).

Establishment of calls in the reverse direction - from a 'phone connected to a private system PABX to a remote 'phone somewhere out in the public system - can be achieved by pre-programming the invention's remote access system with the public system telephone number of the remote 'phone. A call to this number is triggered by the invention's remote access system receiving a ringing signal from the private system. It may be desirable to give the person answering the 'phone some warning that the call has been originated from a private system via a remote access system of the invention, and this can be effected by arranging for some characteristic tone or other audible indication to be applied to the line by the invention's remote access system prior to connecting the two 'phones together. This indication may include a standard voice announcement, or one specially recorded for the purpose during installation or configuration of the invention.

Furthermore, the connection to the original Caller may be made contingent upon the receipt of a specific signal from and known only to the recipient, thereby precluding the possibility of the Caller being connected to a wrong number, or to an unauthorised person who has answered the remote 'phone.

The original call may be answered immediately, and an imitation ringing tone or other audible indication returned while the second call is being set up, or the original call may not be answered until the second call has been accepted.

As so far described, the remote communications system of the invention has a remote 'phone connected via a public telephone system to a private telephone system, and control means interposed between the private

system and the public system allows the remote 'phone to take advantages of the special facilities that the private system offers. Of course, depending upon the exact nature of the remote 'phone, and any other equipment (such as a computer) being used with it, it may be desirable to have the remote 'phone connected into the public system by other suitable control means. Such other control means might be necessary where the remote 'phone is to be connected in parallel with a computer, to enable both the phone's output and the computer's output to be fed into the system simultaneously.

There also exists situations (typically those relevant to very small Companies and individuals working at home) where the private PABX system is absent but nevertheless the ability to transfer calls to a third party after answering them, to have three-way conversations with the Caller and a third party, and to swap between Caller and third party, are very useful. In this case, the remote access system of the invention may incorporate the means to provide these additional functions. as an alternative to a separate PABX.

Embodiments of the invention are now described, though by way of illustration only, with reference to the accompanying schematic Drawings in which:

Figure 1 shows the general layout of a remote telephone connected in accordance with this invention through a public telephone system to another 'phone *via* a private telephone system;

Figure 2 shows the components of the control means employed in the Figure 1 layout; and

Figure 3 shows a slightly more complex layout according to the invention.

Figure 1 shows a number of telephones in a network. One telephone (T<sub>1</sub>) is connected for voice communication via line q to a public telephone network (PTN<sub>1</sub>), while a second 'phone (T<sub>2</sub>) is also connected for voice communication to the same public telephone network PTN<sub>1</sub> but not directly, rather along lines u, t, s and r, and thus *via* a second public telephone network (PTN<sub>2</sub>), a private telephone network (P), and a control means (12). By using the facilities enabled in accordance with the invention by the presence of control means 12, telephone T<sub>1</sub> can talk to telephone T<sub>2</sub> with all the conveniences of being part of the private network P even though in fact it is separated - remote - therefrom by the public network PTN<sub>1</sub>.

PTN<sub>1</sub> and PTN<sub>2</sub> may in practice be the same network.

If the public network PTN<sub>1</sub> is a digital network, then the remote telephone T<sub>1</sub> can advantageously be an integrated ISDN 'phone, so that line q is digital, as is the trunk t from the public network PTN<sub>1</sub> to the private network P (and this will allow the whole call to be achieved with only two-wire hops u, s, thereby adhering to the traditional rules for analogue calls.

Although in Figure 1 link r is shown connected directly between the control means 12 and public network PTN<sub>1</sub>, it may in some cases be preferable to connect it through the PABX for private network P in the same manner as links s and t.

In certain circumstances it may be desirable, as described above, to integrate some of the additional functions provided by the PABX P into the control means 12, particularly in those (usually very small) installations where there is no PABX. In this case, r and s/t will be connected directly to public networks.

A schematic for the working contents of the Figure 1 control means 12, suitable for analogue-to-analogue calls, is shown in Figure 2. The control means includes an analogue line (XY) connected at one end (X) to the public network (PTN<sub>1</sub> in Figure 1) and at the other end (Y) to the private network (P in Figure 1). The line XY contains an audio link with a DC isolation barrier (1; this may also contain amplification and echo-suppression circuitry). On each side, ringing detectors (2,3) are provided to detect ringing current being sent from either end, which detectors respond by closing a DC path (4,5) on either side of the isolation barrier 1. A time-out device (6) can subsequently open these paths; in addition, the path may be opened by the

detection of an audio signal or by some specific pre-defined DC line condition at either end.

The control means also incorporates control signal detect means (7) that detects the "code" signal used to indicate a Recall, and this triggers a Recall-signal generator (8), from which a Recall signal can be fed to the output line (at X) and hence to the private network P to cause it to be alert for any subsequent command signal.

In a version using ISDN - that is, the public network PTN<sub>1</sub> is a digital one - there will be an ISDN terminal adapter between the analogue end X of the Figure 2 control means and the *digital* public network.

The scheme of Figure 3 relates to a digital communications system additionally involving computers talking to other computers; on the side of the remote computer (workstation W) there is control means (B) very like control means A except that it can deal with both voice and digital input and output (as, indeed, can the "A" control means shown in this Figure). The workstation W is communicating with a local area network (L) coupled into the private telephone network's control means A. It is possible to have simultaneous voice communication between the telephones across the public network and between the computers thereacross.

CLAIMS

1. A remote access telecommunications system wherein a facility-providing private telephone system is connectable into some public telephone system whereby it may be linked to a remote 'phone, in which remote access system there is, operationally interposed between the private system and the public system, control means that allows the remote 'phone to send control signals through the public system to the private system so as to cause the private system to operate in the facility-providing manner required.

2. A remote access system as claimed in Claim 1, for connecting together devices that are one or more of "tone" 'phones, digital 'phones and computers.

3. A remote access system as claimed in either of the preceding Claims, wherein connection of either the remote 'phone or the control means into the public system is by digital connection means.

4. A remote access system as claimed in any of the preceding Claims, wherein the control means operationally interposed between the private system and the public system connects - both mechanically/ electrically and as regards signal recognition - into the public system in such a way that, once suitably physically plugged in, it automatically configures itself to fit the public system.

4. A remote access system as claimed in any of the preceding Claims, wherein to enable the control means to recognise when it has received a control signal instructing it to take some action other than merely allowing through whatever information signal is being



transferred from 'phone to 'phone (such an action being to alert the receiving private system to the fact that it is about to be sent a control signal of its own) there is transmitted to the control means a (normally unlikely) sequence of audio tones (applicable for either analogue or digital signals), or as a particular and pre-defined data sequence (digital only).

5. A remote access system as claimed in any of the preceding Claims, wherein, after sending to the control means the special signal to alert the private system that it is about to be sent a control signal, there is then keyed in, at the remote 'phone, a number that defines what action it is to take.

6. A remote access system as claimed in any of the preceding Claims, wherein the control means comprises means for sending onwards in an appropriate format User information (speech signals or computer data) incoming in either direction, as well as means for responding to and sending control information to each of the public and private systems, and means for translating control information received from either system into a suitable format for onwards transmission to other private systems.

7. A remote access system as claimed in Claim 6, wherein the control information to be received and detected includes ringing signals and audio or digital control commands, these being responded to with off-hook and recall signals and audio or digital control commands (suitably translated if necessary).

8. A remote access system as claimed in either of Claims 6 and 7, wherein the control means has a "timeout" capability, forcibly to return both interfaces

to their idle state after a predetermined period of inactivity.

9. A remote access system as claimed in any of Claims 6 to 8, wherein the control means includes a data line connectable between the public and the private systems together with a remote 'phone control signal detect means examining the data line input signals and operatively connected to a private system control signal generator means outputting to the data line output.

10. A remote access system as claimed in Claim 9, wherein in addition the control means includes means for blocking any DC component of the data line signal (so protecting the systems' delicate electronics) but will have means enabling this to be bypassed by a ringing tone (sent from either end), and so has two ringing tone detection means linked one to each of the data line input and output and capable when activated of bypassing the DC block (and to ensure that the system is still protected there is also an associated "time-out" arrangement that will de-activate the bypass after some suitable time)

11. A remote access system as claimed in any of the preceding Claims, wherein establishment of calls from the remote 'phone to the private system via the remote access system of the invention is achieved simply by the remote User dialling the public network number of the line to which the invention's remote access system is connected.

12. A remote access system as claimed in Claim 11, wherein the Caller is then required first to enter a secret code to continue into the private system.

13. A remote access system as claimed in Claim 12, wherein the code is unique to the Caller, and the

private system is configured to call back to the remote 'phone number, which will have been pre-programmed into the remote access system, to confirm that the Caller is entitled to make this use of the system.

14. A remote access system as claimed in any of the preceding Claims, wherein establishment of calls from a 'phone connected to a private system PABX to a remote 'phone somewhere out in the public system is achieved by pre-programming the remote access system with the public system telephone number of the remote 'phone, a call to this number being triggered by the remote access system receiving a ringing signal from the private system.

15. A remote access system as claimed in Claim 14, wherein the person answering the 'phone is given some warning that the call has been originated from a private system via a remote access system of the invention.

16. A remote access system as claimed in Claim 15, wherein this warning can be effected by arranging for some characteristic tone or other audible indication to be applied to the line by the remote access system prior to connecting the two 'phones together.

17. A remote access system as claimed in any of Claims 14, to 16, wherein the connection to the original Caller is made contingent upon the receipt of a specific signal from and known only to the recipient.

18. A remote access system as claimed in any of the preceding Claims, wherein not only is a remote 'phone connected via a public telephone system to a private telephone system, with control means interposed between the private system and the public system allowing the remote 'phone to take advantages of the special facilities that the private system offers, but in

addition, and depending upon the exact nature of the remote 'phone, and any other equipment (such as a computer) being used with it, the remote 'phone is connected into the public system by other suitable control means.

19. A remote access system as claimed in any of the preceding Claims, wherein there is also incorporated the means to provide the additional functions commonly found in a separate PABX.

20. A remote access system as claimed in any of the preceding Claims and substantially as described hereinbefore.

**Patents Act 1977**  
**Examiner's report to the Comptroller under Section 17**  
**(The Search report)**

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**Relevant Technical Fields**

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 (ii) Int Cl (Ed.6) H04M

Search Examiner  
 AL STRAYTON

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 11 MAY 1995

**Databases (see below)**

- (i) UK Patent Office collections of GB, EP, WO and US patent specifications.

Documents considered relevant  
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